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INSTITUTE OF GAS TECHNOLOGY

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GAS ABSTRACTS

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1. GAS INDUSTRY

F.P.C. Control

Morrisey, N. S. FEDERAL CONTROLS HAMSTRING NATURAL-GAS INDUSTRY. *Oil Gas J.*, 54, 160-61 (1956) January 30.

A review of statistics comparing the drilling activity in the natural-gas industry for 1954 and 1955. The author concludes that the reduction in wells drilled is due to fear of Federal controls. R. W. Walters

Gas Reserves

AGA Comm. on Natural Gas Reserves. RESERVES GAIN 12 TRILLION CU FT. *Amer. Gas Assoc. Monthly*, 38, 3-5, 22, 23 (1956) April; Gas Age, 117, 24-26 (1956) April 5; Gas Heat, 7, 46 (1956) April; *Gas*, 32, 167-68 (1956) April; *Oil Gas J.* 54, 282, 83, 85 (1956) April 16.

Reserves achieved a new high level on December 31, 1955, of 223.7 trillion cubic feet, an increase of 12 trillion over the reserves of 211.7 trillion in 1955. Production during 1955 reached a new peak of 10.1 trillion cubic feet, and thus was exceeded again by the annual discoveries, extensions and revisions of reserves. Likewise increases in reserves of crude oil and natural gas liquids also were obtained in 1955, amounting to 451.4 million bbl to total 30.0 billion in the former, and 194.1 million to total 5.4 billion bbl in the latter. Gas in underground storage increased 87.6 billion cu ft to a total of 1,368 billion cu ft. Tabular summaries for the past 10 years are given for this cooperative study with the American Petroleum Institute.
O. P. Brysch

LP-Gas Promotion

McAllister, C. J. BOTTLED GAS—ADVANCE GUARD OF UTILITY SERVICE. *Public Utilities Fortn.*, 57, 145-46 (1956) February 2.

The Liquefied Petroleum Gas Association proposes the creation of a Joint Natural Gas and LP-Gas Council for Unity in order to pool resources for a national gas promotion program. The plan would aid gas utilities in solving their expanding service area problems and develop wider gas markets for the liquefied petroleum gas dealer and gas appliance manufacturer. E. J. Pyrcioch

Operations Research

Brown, A. A. REFINING CAN USE OPERATIONS RESEARCH. *Petorleum Refiner*, 35, 103-05 (1956) February.

Whether determining the optimum storage capacity or establishing the refining required for a certain crude, Operations Research will help you. For a new technique that is fast catching on in progressive companies.
Author's Abstract

Flood, M. M. THIS IS OPERATIONS RESEARCH. *Petroleum Refiner*, 35, 100-02 (1956) February.

Many of the techniques used in OR are old, but their application to business and industrial management is new. Read how OR brings into focus many industrial functions by the use of mathematical models. Author's Abstract

Personnel Resources

National Science Foundation — SCIENTIFIC PERSONNEL RESOURCES. Washington; U. S. Govt. Printing Office; 1955.

This is an 86-page review of data on supply, utilization and training of scientists and engineers. That the shortage of engineers will continue is brought out by the low numbers of graduates:

Year of Graduation	B S Chem. Engs.	B S Mech. Engs.
1948	3,661	9,264
1949	4,206	12,277
1950	4,506	14,441
1951	3,707	10,798
1952	2,857	7,685
1953	2,258	5,964
1954	2,042	5,419

The 1953 median starting salaries of $360 are considerably below the current rate of $400-425.
R. T. Ellington

SUMMER EMPLOYMENT PROGRAMS. *J. College Placement*, 16, 69-78 (1956) March.

The summer employment programs of twenty-two large companies are summarized. More and more emphasis is being placed on these employment periods as a valuable and not too expensive recruiting device. Editor's Abstract

2. APPLIANCES

Appliance Manufacture

HEDGES PAINTS THROUGH A LOOP. *Appliance Mfr.*, 3, 39-40 (1955) August.

A paint saving of 58.7% has resulted from a switch from hand spraying to the electrostatic spray method. The M. M. Hedges Mfg. Co., Inc., Chattanooga, Tenn., stepped up painting of water-heater jackets from five 30-gal jackets per gallon of enamel to,—with Ransburg process No. 1, increase of 8 jackets, Ransburg process No. 2, 12 jackets painted with 1 gallon. In the present set-up production has been tripled, from 60 to 180 jackets per hour.

J. G. Chalcraft

A NEW PACKAGE FOR RHEEM. *Appliance Mfr.*, 3, 28-31 (1955) August.

By changing its packaging of water heaters from wire-bound boxes and wooden crates to corrugated cartons, the Rheem Mfg. Co. has gained some basic advantages: 1) consumers receive heaters in factory built condition, clean and unscratched; 2) valuable advertising space; 3) space and weight are saved; 4) corrugated cartons cost less. After a series of tests the operation has been put into full operation.

J. G. Chalcraft

Appliance Venting

Reed, H. L. A FIELD SURVEY OF GAS APPLIANCE VENTING CONDITIONS. Amer. Gas Assoc. Lab. Res. Rep. No. 1243 (1956) February.

Gas appliance venting data are presented on the basis of widely varying, but nevertheless, typical operating conditions throughout the United States. A statistical analysis of the major draft variables indicates that maximum flue connector velocities under all conditions ranges from 0.5 to 13 miles per hour; maximum static pressures in the vent connectors ranged from zero to minus 0.18 inch water column. In addition, the flue gas temperatures ranges from 90° to 490°F leaving the draft hood and from 125° to 900°F entering the draft hood. Incident to the temperatures, carbon dioxide concentrations were found to vary from 3.0 to 12.0 per cent by volume of the flue gases entering draft hoods, and from 0.5 to 8.5 per cent by volume of the flue gases leaving the draft hoods. Calculated draft hood dilution effects indicate exit to entering weight flow ratios ranging from 1:1 to 7.3:1. Normal updrafts and maximum downdrafts recorded during the survey were generally found to fall within the limits of the drafts specified in the American standard approval requirements for gas appliances. In addition, spillage was indicated to be a problem, especially during summertime water heater operation. Also, data reported from several installations of dual venting into a common flue indicate the the influence from one appliance on the draft in the second vent connector is the same whether or not the second appliance is operating included in appendix C is an interpretation of the origin of the present American standard approval requirement and test procedure for updraft. Independent results and conclusions of a field survey by a gas company on incinerators and large installations is given in appendix D. The field survey of draft conditions was conducted as a PAR plan activity, sponsored by the American Gas Association's Committee on domestic gas research. This report represents Phase II of Project DA-3-HA, "Appraisal of Available Information on Venting Gas Appliances and Field Survey of Draft Conditions".

Author's Abstract

Commercial Hot Water

Reiter, F. M. SERVICE HOT WATER FOR COMMERCIAL AND INDUSTRIAL USE. *Air Conditioning, Heating Ventilating*, 53, 90-101 (1956) February.

Presented for the design engineer are specific figures on the amount of service hot water required for dishwashers and other units in various types of restaurant kitchens, laundries, and for the many industrial and process applications which require large amounts of hot water. Factual data are helpful for laying out such systems.

Author's Abstract

Controls & Ignition

Brodbeck, A. H., and Douglas, B. C. (assigned to Magic Chef, Inc.) IGNITER SYSTEMS FOR GAS RANGES. U. S. 2,735,483 (1956) February 21.

Hoff, J. M. (assigned to The Tappan Stove Co.) AUTOMATIC IGNITION AND CONTROL

MECHANISM FOR GASEOUS FUEL BURNERS. U. S. 2,735,484 (1956) February 21.

Newell, R. E. ELECTRICALLY CONTROLLED VALVE FOR GAS LINES AND THE LIKE. U. S. 2,734,563 (1956) February 14.

Ray, W. A. (assigned to General Controls Co.) GAS-BURNER CONTROL SYSTEM. U. S. 2,734,564 (1956) February 14.

Shaw, B. C. AUTOMATIC TEMPERATURE CONTROLS FOR COMMERCIAL GAS COOKING EQUIPMENT. Amer. Gas Assoc. Lab. Res. Bull. No. 70 (1956) February.

Design criteria are developed and a mathematical analysis of the appliance-control system is presented to aid equipment manufacturers in selecting thermostats with proper characteristics, and in installing them so as to provide optimum performance. Contemporary commercial appliance thermostats of recent design were found satisfactory for use in commercial appliances if properly applied. Light-duty domestic range thermostats were found unsatisfactory for use in most commercial appliances. Most of the difficulties encountered in the field with commercial equipment thermostats were found to be the result of materials failure in older types of controls, poor judgment in selection of a control for an appliance, and abuse by the user. The possible uses of some new and unusual controls are discussed, particularly the merits and disadvantages of dial thermometers and of timers as applied to commercial equipment. Lines of endeavor which might be followed for further improvement of commercial controls are suggested throughout the text.

Author's Abstract

Water Heater

KITCHEN HEATER. *Gas J.* (British), 285, 54 (1956) January 4.

This article describes the Ascot table-top balanced-flue water heater, which takes combustion air from and discharges products to a point on the outside wall below table top level.

R. T. Ellington

3. COMBUSTION AND INDUSTRIAL FURNACES

Burner Design

Reed, R. D. HYDROGEN FUEL MAKES PROBLEMS. *Petroleum Ref.*, 34, 153-54 (1955) November.

The requirements of a burner to be used in the fuels with high hydrogen content are discussed. Satisfactory operation can be obtained with proper venturi, burner, and furnace design.

S. A. Weil

Exhaust Hoods

Epple, A. B. EXHAUST HOOD TESTS PROVIDE DESIGN DATA. *Heating, Piping, Air Cond.*, 28, 116-19 (1956) February.

Four types of exhaust hoods were studied and values of minimum velocity developed. Some conclusions reached were that,—the entry coefficient values of 0.85 to 0.93 for canopy hoods and the push-pull system give satisfactory collection in the absence of cross drafts,—with cross drafts over the push-pull system, the suction volume must be increased to maintain control,—a double canopy hood with a center opening shows a uniform velocity across the hood face and a higher rim velocity for the same volume than does the plain canopy.

Author's Abstract

Flame Research

Ingold, K. U. and Bryce, W. A. MASS SPECTROMETRIC INVESTIGATION OF THE HYDROGEN-OXYGEN AND METHYL-OXYGEN REACTIONS. *J. Chem. Physics*, 24, 360-64 (1956) February.

Analysis of the compounds present during the hydrogen-oxygen reaction indicated H_2O_2, HO_2, and OH. No atomic hydrogen or atomic oxygen was detected nor any H_2O_4 found. The reaction of methyl radicals with oxygen was also investigated using mercury dimethyl as the sources of methyl radicals. Species detected were CH_3, CH_2, CH_3O_2, CH_3O, OH, HO_2, and CHO. A tentative mechanism is offered to account for these.

S. A. Weil

Williams, K. G., Johnson, J. E. and Carhart, H. W. SAMPLING STUDIES OF COOL

FLAMES. *Ind. Eng. Chem.*, 47, 2528-32 (1955) December.

During attempts to sample the gases of cool flames, it was found that the properties of the probe itself strongly affected the results and that reaction was not quenched even in probes 0.6 mm. The results with various probe diameters, sampling velocities, and probe lengths are discussed in terms of possible reaction mechanisms within the probe. S. A. Weil

Industrial Heating

Mawhinney, M. H. HEAT TRANSFER IN INDUSTRIAL HEATING FURNACES: II. *Ind. Heating*, 23, 54-66 (1956) January.

A review of theory of heat transfer in industrial furnaces was presented in Part I of this article so that the following interpretation of practical data may be more easily understood. Practical data for various conditions of heating steel and for heating copper and aluminum is presented and theoretical application of the data is discussed in this installment. Author's Abstract

Mawhinney, M. H. HEAT TRANSFER IN INDUSTRIAL HEATING FURNACE: III. *Ind. Heating*, 23, 292-306 (1956) February.

A study of theory, outlined in Part I, and theoretical application of practical data for various conditions for heating ferrous and non-ferrous metals, presented in Part II, has led to the development of a series of curves to enable a more accurate calculation of heat transfer than can be determined on the basis of straight-line relation of rate of heating of steel in lb/hr/sq ft of hearth area and the overall coefficient of heat transfer. Use of these surveys, establishing a relation between ratio of flow of heat to area of hearth surface and ratio of area of heated surface to area of refractories, for calculating heat transfer are presented in this concluding installment. Author's Abstract

Power Reactors

Ely, O. SLOW PROGRESS IN POWER REACTOR DEVELOPMENT. *Public Utilities Fortn.*, 57, 176-81 (1956) February 2.

A review of progress on the commercial nuclear reactor program for power generation is given. Several statements of costs are given which are contradictory unless military or civilian use is kept in mind. W. G. Bair

Submerged Combustion

Cronan, C. S. SUBMERGED COMBUSTION FLARES ANEW. *Chem. Eng.*, 63, 163-67 (1956) February.

This article describes the basic process of submerged combustion equipment, and process applications which utilize the advantages of low first cost, minimum scaling and corrosion, and high thermal efficiency. R. T. Ellington

Utility Fuel Costs

Richmond, K. C. SOME VARIATIONS IN AND YARDSTICKS ON FUEL HANDLING COSTS. *Coal-Heat*, 71, 13-19 (1956) February.

One of a series on fuel economics based on an analysis of reports to the Federal Power Commission by 365 companies representing 890 steam-electric utility stations in 46 states—the use of over 100 million tons of coal, some gas and oil, in 1954. Author's Abstract

Wall Emissivities

De Corso, S. M. and Coit, R. L. MEASUREMENT OF TOTAL EMISSIVITIES OF GAS-TURBINE COMBUSTION MATERIALS. *Amer. Soc. Mech. Eng.*, 77, 1189-97 (1955) November.

A procedure and apparatus for measuring emissivities is described. Data is presented for various metals with untreated, sand-blasted, and ceramics-coated surfaces. It was found that combustion wall temperatures can be appreciably reduced by coating the internal surfaces and sand blasting the external surfaces.

S. A. Weil

4. CARBONIZATION AND GASIFICATION

Char Boiler Fuel

Chukhanov, Z. F., Khitrin, L. N., and Golubtzov, V. A. METHOD FOR THE COMBINED PROCESSING AND POWER UTILIZATION OF SOLID FUELS. *Eng. Digest* (British), 17, 61-63, 80 (1956) February.

This Russian contribution urges a processing scheme for coal to recover valuable byproducts before combustion. Flue gas would be used to heat the coarse-grained fuel in a retort to 350-500° C. The hot fuel would then be mixed with powdered coke and heated to thermal dissociation temperature (550-750° C.) in a large chamber from which gas and tar may be re-

covered. The solid residue would be partially burned at 800-1100° C. yielding fines to be burned in a boiler furnace for power production, and larger particles of coke to be sent back to the thermal dissociation chamber. Much greater efficiencies are claimed for such a combination plant. Product yields from various coals and shales at various processing temperatures are given graphically. E. B. Shultz

Coal Adsorption

Kini, K. A., Nandi, S. P., Sharma, J. N., Iyengar, M. S. and Lahiri, A. SURFACE AREA OF COAL. *Fuel* (British) **35**, 71-76 (1956) January.

Evidence is presented to show that the controversy concerning the surface area of coal is not yet resolved. A study of the adsorption of polar and non-polar gases by a British anthracite, heats of wetting in polar liquids of a low-rank Madhya Pradesh coal and BET measurements using argon and heats of wetting in methanol of a briquetted Raniganj coal has shown that polar interaction (or hydrogen bonding) is an important factor in explaining the anomaly of the surface area of coal. Authors' Abstract

Coal Logs

Cellan-Jones, G. THE PRODUCTION OF BLENDING COKE AND SMOKELESS FUEL. *Coke and Gas* (British), **18**, 52-5, 61 (1956) February.

The author describes a pilot plant and results of the "Coal Logs" process, which is under development in England. Plans include production of loose, unagglomerated char for addition to coal-blends in the production of strong blast-furnace coke, as well as the compressed, extruded "logs" (10 to 15 percent volatile matter) desirable as a dense smokeless domestic fuel. The char thus can be locally produced from any coals to replace expensive anthracite in the furnace coke blends. However the domestic "logs" require a coal which attains the pasty stage during carbonization. O. P. Brysch

Coal Mineral Removal

Campbell, R. J., Jr., Hilton, R. J., and Boyd, C. L. COAL AS A SOURCE OF ELECTRODE CARBON IN ALUMINUM PRODUCTION. U. S. Bur. Mines Rept. Inv. 5191 (1956) February.

With the rise in aluminum producing capacity in the U. S., the 1955 requirements for electrode carbon were above 1,100,000 tons, and eventual exhaustion of supplies of petroleum coke so used was indicated. As an alternative source of carbon, bench-scale studies of coal purification were conducted. Results are given of studies of the 15 U.S. coals, purified by specific-gravity separation, froth flotation, aqueous leaching of ash (acid and alkali), solvent extraction of coal, and acid washing of coal solutions. Considerable analytical data is tabulated to show the ash reduction by the various treatments. Older work in this field is reviewed in 94 citations. O. P. Brysch

Gas Mixing

Warner, C. W. CONTROL OF GAS MIXING PROCESS. PART I. *Gas*, **32**, 37-40 (1956) February.

The problems in the accurate mixing of fuel gases are discussed. The reasons for using mixture heating value for controlling the mixing process are presented. The effect of errors in proportioning the gases are discussed. S. A. Weil

Graphitic Coke

Smith, A. P. (assigned to Smith-Byrne Co., Inc.) GRAPHITE CONTAINING METALLURGICAL COKE AND PROCESS FOR ITS MANUFACTURE. U. S. 2,732,333 (1956) January 24.

A metallurgical coke composition and process is claimed, in which 4 to 20 percent natural amorphous graphite is blended with a crushed (⅜-inch) caking coal and the mixture coked for 72 to 96 hours in a beehive oven at 2000°-2400° F. Special advantages for foundry use are indicated, because of high graphite solubility in the iron. O. P. Brysch

Methane Recovery

Palmer, C. D. METHANE DRAINAGE IN COAL MINES. *Gas J.* (British), **285**, 45-7 (1956) January 4.

If 50 percent of all methane in the coal mines of Britain could be drained for utilization as fuel, the country would have an additional 500 million therms a year. This could be achieved by drilling drain-holes and inserting pipes 200 ft long at a 45° angle into the disturbed rock strata above the mined-out areas of the long wall advance of the seam face. Connection of

boreholes to a collection main in the return air-way, and application of suction from the surface, would reduce the methane in the mine air to a safe level and permit use of the gas as colliery boilerfuel, engine fuel, gas utility supply or reformed gas for chemical synthesis.

O. P. Brysch

Oil Gas

Coombe, R. B. AUTOMATIC CONTROL FOR GAS MAKING MACHINES. U. S. 2,730,437 (1956) January 10.

The process proposes to gain a constant cycle operation for a conventional oil gas making machine by regulating automatically the internal temperature of the checker chambers thereof through varying the supply of make oil introduced thereto during the make phase of the gasification cycle; the determination of the rate of make oil supply being correlated to a pyrometric indication of the checker chambers' internal temperature, with the total results of the proposed control means being to approach a desired constant chamber temperature during the make phase to bring about an efficient and improved gasification cycle of a given and predetermined duration which is maintained constant for repeated or successive cycles of each gas making machine. Author's Abstract

Pettyjohn, E. S. and Linden, H. R. (assigned to Institute of Gas Technology, Chicago) METHOD OF MAKING A FUEL GAS INTERCHANGEABLE WITH NATURAL GAS. U. S. 2,734,809 (1956) February 14.

This invention relates to a method for converting natural gas liquids and petroleum distillates with a final boiling point not exceeding 500° F. into a 100% natural gas substitute by continuous thermal cracking in a tube furnace (preferably at total pressures from 2-4 atmospheres), separating the liquid products, and passing the gaseous products over hydrogenation catalysts such as reduced nickel oxide to convert the olefinic constituents and free hydrogen into the corresponding paraffins. H. R. Linden

Pettyjohn, E. S., Linden, H. R., and Lee, W. L. (assigned to Institute of Gas Technology, Chicago) METHOD OF MAKING OIL GAS INTERCHANGEABLE WITH NATURAL GAS. U. S. 2,734,810 (1956) February 14.

This invention relates to a method of producing high Btu oil gas in cyclic-regenerative sets by introducing low molecular weight hydrocarbons such as propane, butane or light petroleum distillates into the upstream superheater during the make period, and correspondingly reducing the quantities of make steam, while using the normal amount of heavy oil in the generators. This results in a substantial increase in set capacity as a result of production of gaseous products from these low molecular weight hydrocarbons similar in composition to high Btu oil gas without additional heat requirements. The quality of the gas is also improved as a result of reduced blast gas dilution and of the higher partial pressure. H. R. Linden

Totzek, F. and Linder, W. (assigned to Koppers Co., Inc.) METHOD FOR THE PRODUCTION OF FUEL GAS FROM LIQUID FUELS. U. S. 2,734,811 (1956) February 14.

A water gas is produced by steam pyrolysis of hydrocarbons, using a cyclic regenerative system for preheat, and partial oxidation in the reaction zone of a portion of the hydrocarbon to supply the endothermic heat of reaction.

E. B. Shultz

Pitch Coking

Fuchs, W. and Gewers, C. UEBER DIE STEIGERUNG DER WERTSTOFFAUSBEUTE BEI DER VERKOKUNG DURCH ZUSAETZE VON GATSCHEN UND PECHEN ZUR KOKSKOHLE. (ON THE INCREASE OF YIELDS OF VALUABLE PRODUCTS DURING CARBONIZATION THROUGH ADDITIONS OF CRUDE WAXES AND PITCHES TO COKING COAL). *Erdoel und Kohle* (German), 9, 87-90 (1956) February.

Improved yields of benzene, ethylene and methane are obtained by the authors on a laboratory scale by adding tar pitch, crude wax and stearine pitches to coking coal charges in amounts from zero to 10 percent. Tar pitch alone gave poorer yields because of its high content of high molecular, condensed ring compounds. Results are shown graphically.

O. P. Brysch

Geller, J. (assigned to Rutgerswerke-A.-G.) COKING OF BITUMINOUS SUBSTANCES. U. S. 2,732,332 (1956) January 24.

Pitch from meltable bituminous materials is first distilled in an indirectly heated shaft, and

the molten residue is fed vertically downward through a coking zone to form discrete coked particles, which are calcined at 1000° in a lower section by partial combustion with air. The calcined coke is screw-discharged, and the volatile gases are burned in a jacket around the coking zone. O. P. Brysch

Purification

Gollmar, H. A. and Hodge, W. W. VACUUM CARBONATE PROCESS FOR RECOVERY OF HYDROGEN SULFIDE AND CYANIDE COMPOUNDS. Purdue Univ. Engrg. Bull., Proc. 10th Indust. Waste Conf., 35-48, Lafayette, Ind. (1956) March.

The above process as applied to the purification of coke-oven gas is described, together with a discussion of the effects of other ingredients in the gas (CO_2, NH_3, naphthalene). Processes for purification of the recovered H_2S and HCN are also discussed. D. M. Mason

Herbert, W. DAS RECTISOL-VERFAHREN ZUR REINIGUNG VON DRUCKGASEN. (THE RECTISOL PROCESS FOR PURIFICATION OF GASES UNDER PRESSURE). *Erdoel und Kohle* (German), 9, 77-81 (1956) February.

After a review of earlier purification methods for Fischer-Tropsch synthesis gases, the author outlines the fundamentals of the "one-wash", complete purification in the Rectisol process, as required for extremely large gas throughput. The process is based on the 75-fold solubility of CO_2 in methanol at —70° C., as compared to 40° C. A two-stage washer is used, in which the first stage operates at high methanol recirculation at —75° to —20° C., at 25 atm, and the wash is regenerated by "depressurizing" the methanol down to 0.2 atm, which releases most of the CO_2 and also re-cools the methanol to —75° C. In the second washing stage, a smaller recycling portion of the methanol is regenerated by heating to 65° C. to boil off the other impurities, and re-cooled to —62° by heat exchangers. Heat-regenerators of the Linde-Frankl type are used to precool incoming gas with CO_2 off-gas and with purified gas, at which point light oils and water are removed. Application of this process at the Sasol, South African synthesis plant is described, where over 6.5 million CF per hour of gas is purified of CO_2 HCN, NH_3, light oils, H_2S, organic S, moisture and resin-former content. A second unit purifies 1.5 million CF/hour of plant tail-gas, removing light oils, $C_3 + C_4$ and CO_2. O. P. Brysch

Willmott, L. F., Batchelder, H. R., Wenzell, L. P., Jr., and Hirst, L. L. PERFORMANCE OF A GIRBOTOL PURIFICATION PLANT AT LOUISIANA, MO. U. S. Bur. Mines Rept. of Inv. 5196 (1956) February.

This report is the first description of semi-commercial-scale application of the amine process to the purification of synthesis gas produced from coal or coke for Fischer-Tropsch synthesis. A brief account of each run and a summary of the operational data are presented. A material balance is given for a period typical of the operation with a gas produced from coke. After the first two preliminary runs the unit performed satisfactorily, with the gas from an oxygen-blown coke producer. The following conclusions were reached: 1) The Girbotol unit effectively removed the bulk of the carbon dioxide and hydrogen sulfide from synthesis gas produced either from coke or directly from coal. 2) The performance of the unit indicated the need for further research into a) the causes and control of corrosion of the materials of construction of the unit with such research evaluating the effects of temperature and intermittance of operation and b) the cause of foaming in the reboiler and means for abating it. Authors' Abstract

Producer Gas

Scott, W. THE MANUFACTURE OF COLD CLEAN PRODUCER GAS. (Review No. 155) *British Coal Utiliz. Res. Monthly Bull.*, 20, 1-8 (1956), January.

Current methods for the production of cold clean producer gas, which essentially involve tar and heat removal, are reviewed and discussed. Included are water- and oil-washing processes as well as methods practiced in two-stage producers and in coke and anthracite producers. In general, the loss of tar heating value and the sensible heat in the gas are the more significant for the cleaning costs than are either capital or operating costs, and are only partially offset by tar credits. E. J. Pyrcioch

Synthesis Gas

Tuttle, M. H. (assigned to Hydrocarbon Research, Inc.) BURNERS FOR THE PRODUCTION OF SYNTHESIS GAS. U. S. 2,735,482 (1956) February 21.

One embodiment of this invention provides for the admixing of the hydrocarbon gas and oxygen within the burner and the discharge of the mixture in a large number of parallel-flowing small streams into the reaction zone. In the other embodiment, the hydrocarbon gas and oxygen are introduced into the reaction zone separately as alternate adjacent streams in parallel flow. E. J. Pyrcioch

Wood Carbonization

Mora, F. M. METHOD AND RETORT ARRANGEMENT FOR CARBONIZING SAWDUST FROM WOOD. U.S. 2,735,805 (1956) February 21.

Dried sawdust is preheated in a charging hopper from which it is fed by a rotary pocket feeder to a fixed vertical shaft retort and carbonized at progressively increasing temperatures during its downward movement. The retort is heated externally by spiral flow of combustion gases in a concentric ceramic housing. The distillation gases collected through a perforated pipe at the retort axis are used as fuel. The collected flue gases from retort top are used in the feeding conveyor tunnel to dry the incoming sawdust before they are discharged to a stack. O. P. Brysch

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Compression

Lafferty, H. B. GAS DISPATCHER'S EXPERIENCE WITH TURBINE COMPRESSOR STATIONS. *Gas*, 32, 109-113 (1956) February.

This informative article includes drawings and graphs illustrating the conditions in which the operating experience cited was gained. The advantages and disadvantages of the turbine station are given from a dispatchers point of view. R. F. Bukacek

Salls, D. M. AUTOMATIC ENGINE-DRIVEN CENTRIFUGAL COMPRESSOR GOES ON MAIN-LINE SERVICE. *Oil Gas J.*, 54, 111-12 (1956) February 20; *Gas Age*, 117, 36-37, 69, 72-73 (1956) March 8.

The satellite compressor station developed jointly by Gulf Interstate Gas Co. and Cooper-Bessemer Corporation is described.

R. F. Bukacek

GULF INTERSTATE'S GAS ENGINE CENTRIFUGAL SATELLITE STATION BOW IN OPERATION. *Pipe Line News*, 28, 42-43 (1956) February.

A description of an unattended, remotely controlled centrifugal compressor station recently placed in operation by the Gulf Interstate Gas Co. Brief outlines of the compressor starting and shut down procedures and of the safety devices used are included. G. G. Wilson

Construction Safety

Keens, G. SAFETY PROCEDURES USED IN WORKING ON GAS PIPE LINES. *Pipe Line News*, 28, 29-30 (1956) February.

The safety precautions used by the Southern Counties Gas Company on jobs involving the relocation of a gas line are outlined and illustrated in detail for a typical job.

G. G. Wilson

Drilling

Campise, N. O. EVOLUTION OF LOW SOLIDS DRILLING FLUIDS. *World Oil*, 142, 102-04 (156) February 1.

Lower mud costs, better viscosity and gel control, and faster drilling rates are focusing attention on centrifugal separation of solids from drilling muds. Claims for this process of mud control are outlined. B. E. Eakin

Eckel, J. E., Deily, F. H., and Ledgerwood, L. W., Jr. DEVELOPMENT AND TESTING OF JET PUMP PELLET IMPACT DRILL BITS. (T. P. 4202). *J. Petroleum Techn.*, 8, 1-10 (1956) January.

The experimental laboratory work and analytical procedures utilized in developing a better understanding of the process, and evaluating such factors as pellet-size and velocity, jet pump characteristics and modifications, and power transfer, are described. The design and con-

struction of a 9-inch pellet impact bit utilizing 1¼ inch steel pellets, and the drilling performance, hydraulic operating characteristics, and metallurgical problems are discussed.

B. E. Eakin

DRAINHOLES POINT EASTWARD. *Petroleum Week*, 2, 19-20 (1956) January 27.

The technique of drilling almost horizontal holes into the productive formation in order to increase the effective drainage of a well is evidently moving eastward from its origin in California. This article reports on the activity presently being pushed in the Texas area.

B. E. Eakin

Exploration

Levorsen, A. I. GEOLOGISTS ARE TALKING ABOUT . . *Petroleum Eng.*, B39-47 (1956) February; *Oil Gas J.* 54, 104-109 (1956) April 30.

An optimistic attitude on oil-finding in this country is essential, and there exist numerous possibilities that should be fully explored in view of well-known facts and new developments. This report gives some views on where our new oil is going to come from and how we will find it, perhaps in stratigraphic traps, anticlines, and older formations (Cambro-Ordovician).

B. E. Eakin

WORLD'S DEEPEST WELL NOW AT 22,570 FEET. *Petroleum Eng.*, 28, B29-30 (1956) February.

The deepest well (Richardson & Ross, near Port Sulphur, La.) has exhibited evidence of a number of excellent shows at depths below 20,500 feet, which could make it the deepest producer. The trouble-free drilling record as attributed to a well planned and carefully followed mud program.

B. E. Eakin

RECORD WORLD EXPLORATION IN 1956. *World Petroleum*, 27, 64-8, 108-11 (1956) March.

The entry of independent operators into exploration activities in areas outside the U. S. helped raise the 1956 geophysical reconnaissance to a high level. Some of the more important wildcat operations throughout the world are described.

B. E. Eakin

Flow Measurement

Bertuzzi, A. E., Tek, M. R., Pettmann, F. H. SIMULTANEOUS FLOW OF LIQUID AND GAS THROUGH HORIZONTAL PIPE. *J. Petroleum Techn.*, 8, 17-24 (1956) January.

A method is proposed for predicting pressure drop for two-phase flow in horizontal pipes, and has been reduced to a simplified graphical procedure suitable for field work. The method is based on a two-phase f factor, defined and correlated with parameters including flowing gas-liquid mass ratio, and gas and liquid phase Reynolds numbers. An example is presented outlining the calculation procedure.

B. E. Eakin

Foulke, G. REMOTE CONTROL OF GAS FLOW AT DELIVERY MEASURING STATIONS. *Amer. Gas J.*, 183, 23-24 (1956) February.

Remotely-operated flow controller systems installed at two metering stations of the Gulf Interstate Gas Company are described. These controller systems permit remote operation of diaphragm valves on the primary meter runs at the metering station by means of an impulse type telemeter circuit.

G. G. Wilson

Newman, C. ORIFICE PLATE ERRORS DUE TO PULSATIVE GAS FLOW. *Petroleum Eng.*, 28, B73, 76-78 (1956) February.

An analysis of orifice metering errors due to pulsative flow, with experimental data given showing the agreement between theory and experiment.

R. F. Bukacek

LP-Gas Handling

Branyan, S. G. HOW ANCHOR RECOVERS 97% OF LPG STORED UNDERGROUND. *World Oil*, 142, 147-49 (1956) February 1.

A description of completion practices, surface handling and storage techniques which have made it possible to make very high recoveries from underground salt cavern storage.

R. F. Bukacek

Phelps, S. C. CURRENT PRACTICES IN DISPLACING LIQUID HYDROCARBONS

FROM PIPE LINES. *Petroleum Eng.*, 28, D28-30, 32, 34, 36 (1956) February.

The advantages and disadvantages of five different substances commonly used to displace liquid hydrocarbons from pipelines are discussed. An outline of the basic objectives of displacing the line load is included.

G. G. Wilson

McKinney, C. O. (assigned to Standard Oil Co.) LIQUIFIED PETROLEUM GAS PRODUCTION. U. S. 2,727,367 (1955) December 20.

A cyclic process is described for the production of dry LP-gas liquids from moist feed stock. The process is claimed to be more economic than present methods. B. E. Eakin

New York Gas Field

Brundage, H. T. NATURAL GAS PRODUCTION 100 MILES FROM NEW YORK CITY. *World Oil*, 142, 40-42 (1956) February 1.

Recent wildcat activity in the Catskill Mountains area has resulted in possibly a new gas supply. Tests presently being conducted on the Oriskany and Silurian horizons raised hope for natural gas production. B. E. Eakin

Offshore Operations

Calvert, J. W. SEAGOING SKYSCRAPERS. *World Petroleum*, 27, 74-77 (1956) March.

Some of the new offshore drilling units are described, and present wells and wildcats discussed. Current output of offshore wells averages 62,000 barrels daily. B. E. Eakin

Martin, C. K., Jr. THAT SUBMARINE DRILLING RIG PLAN INTRIGUES THE INDUSTRY. *Drilling*, 17, 87-88 (1956) January.

This article answers some of the questions that have been asked concerning the proposed submersible drilling rig. This rig is to be designed to operate in from 200 to 600 feet of water, to be set on the bottom, and to be supplied with power from a ship at the surface. All of the proposed techniques have already been proven in the marine industry. B. E. Eakin

Pipeline Design

Ford, S. D. HOW TO DESIGN YOUR PIPELINE. *Gas*, 32, 116-20 (1956) February.

The author shows the application of the Weymouth equation and the ASA B31.1.8 (1955) code to several simple design problems.

R. F. Bukacek

Reservoir Engineering

Cornell, D. APPLYING VAN EVERDINGEN AND HURST SOLUTIONS TO NATURAL GAS FLOW PROBLEMS. *World Oil*, 142, 134-36 (1956) February 1.

The author shows the application of Van Everdingen and Hurst's solutions to the equation for radial flow toward a producing well in unsteady state. R. F. Bukacek

Jones, R. G. SOME COMPARISONS OF AIR-PERMEABILITY AND WATER-INPUT PROFILES, SOUTHEASTERN ILLINOIS WATER FLOODS. *Producers Monthly*, 20, 19-21, 24-25 (1956) January.

This article summarizes the results of air-permeability and water-input profile comparison for six wells. The results indicate an equilization trend, over the life of the water floods concerned, which contributes to a greater vertical flooding efficiency than indicated by permeability profiles. B. E. Eakin

Stahl, C. D. A METHOD OF PREDICTION OF INPUT BEHAVIOR OF HETEROGENEOUS SANDS. *Producers Monthly*, 20, 26 (1956) January.

An illustration of the calculation procedure is given for a uniform five-spot injection pattern.

B. E. Eakin

Stephens, F. PRESSURE MAINTENANCE AND SECONDARY RECOVERY, RUSSELL POOL, EDDY COUNTY, NEW MEXICO. *Producers Monthly*, 20, 31-35 (1956) January.

The results of the pilot water flooding project indicate that an estimated additional profit of $1,400,000 will be realized from the Russell Pool as a result of complete water flooding. The production and economic analysis of the pilot project are given. B. E. Eakin

San Juan Basin

Woods, C. THE TOWN THAT GAS BUILT. *Compressed Air*, 61, 52-53 (1956) February.
Farmington, New Mexico, is a town whose expansion is due chiefly to natural gas production in the San Juan Basin. Within communities throughout the Rocky Mountains, some 1200 gas wells and 100 oil wells are now producing and this is only the beginning for that region.
J. R. Hasenberg

Underground Line Survey

Krueger, W. F. THE MOLE, WHAT IT IS AND HOW IT WORKS. *Petroleum Eng.*, 28, D12-15 (1956) February.

A description of equipment recently developed to survey pipeline at underwater river crossings. The equipment consists basically of an inclinometer, gyroscope, and movie camera in a housing which pulled through the pipeline.
R. F. Bukacek

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Fluid Coking

Boston, E. D., and Smith, B. I. (assigned to Esso Research and Eng. Co.) USE OF NORMALLY GASEOUS HYDROCARBON FOR STRIPPING OF CIRCULATING COKE IN A FLUIDIZED COKING PROCESS. U. S. 2,735,804 (1956) February 21.

In coking heavy hydrocarbon oils to unsaturated hydrocarbons, aromatics and coke in a fluidized system, the circulating coke particles contain occluded gases such as carbon oxides, nitrogen and oxygen from the combustion zone. The inventor claims an improvement wherein the hot circulating coke is continuously stripped with a gaseous hydrocarbon, such as ethane, which is dehydrogenated to ethylene in the process.
E. B. Shultz

Hydrogenation

Gilmartin, R. P., Horne, W. A., and Walsh, B. R. HYDROGEN TREATMENT IMPROVES FUEL OILS. *Oil Gas J.*, 54, 85-88 (1956) February 6.
Use of a hydrogenation process in the manufacture of No. 2 fuel oils offers an attractive method for upgrading the quality of these fuels and improving their performance in heating oil equipment and in diesel engines. A substantial reduction in sulfur content and in carbon residue on 10% bottoms results. Color stability and resistance to formation of sludge in storage are also greatly improved.
D. M. Mason

Stuart, A. P. (assigned to Sun Oil Co.) HYDROGENATION OF UNSATURATED HYDROCARBONS EMPLOYING A METAL SULFIDE CATALYST HAVING A NITROGENOUS BASE CHEMISORBED THEREON. U. S. 2,736,689 (1956) February 28.

This patent claims to prepare an effective hydrogenation catalyst by adding a small amount of nitrogen-containing organic base such as pyridine or quinoline to a metal sulfide-acidic carrier type catalyst.
E. B. Shultz

Petroleum Reserves

Torrey, P. D. OIL RESOURCES OF THE UNITED STATES. *Petroleum Eng.*, 28, B116-120 (1956) February.

The petroleum reserves of the U. S. are predicted with confidence to be in the range of 40 billion barrels rather than the figure popularly quoted of 29-plus billion bbls. This is based on improved methods of secondary recovery. Even so, if the best known and field proven recovery methods were applied to all fields still only 32.4% of the oil in the reservoirs would be recovered. This points up the need for continued research in petroleum recovery techniques.
B. E. Eakin

Poisoned Catalysts

Maxted, E. B. and Josephs, M. THE REVERSIBILITY OF THE ADSORPTION OF CATALYST POISONS. PART IV. REVIVAL OF POISONED CATALYSTS BY GAS-PHASE DESORPTION. *J. Chem. Soc.* (British), 264-72 (1956) February.

Platinum hydrogenation catalysts poisoned by thiophene or diethyl sulfide are revived by desorption of the poison into the gas phase, by simple evacuation, by circulating an inert gas, or ethylene through the poisoned catalyst at room temperature. The poison is displaced by competitive adsorption of a second substrate.
E. B. Shultz

Railroad Diesel Fuel

Stormont, D. H. RAILROADS MAY ADOPT NEW FUEL PATTERN. *Oil Gas J.*, 54, 84-85 (1956) February 20.

Possible consequences are discussed if a dual-fuel system is adopted by railroads for diesel locomotives. Distillate fuel would be used for idling and low-load conditions, residual oils for medium and high loads with switching from one to another controlled automatically. Residual oils tested satisfactorily by Southern Pacific in a one year program have had viscosities about 300 S.S.U. at 100° F., API gravities from 16 to 17° and sulfur contents of 2.5 to 3 percent. In addition to savings from the lower price of residual fuel, an additional 5 percent cost reduction occurs due to the higher heat content of the residual fuel. If the system is widely adopted, price of residual may rise and more straight-run distillates may be available for other markets or as feed for catalytic cracking units. E. B. Shultz

Shale Oil Activities

Cameron, R. J. WHERE OIL SHALE STANDS TODAY. *World Petroleum*, 27, 58-61 (1956) February.

This very readable review of current happenings in the developing oil-shale industry describes the increasing land activity, the plans of the Union Oil Co. and others for expansion, and the possibility that the U. S. Navy may take over the Bureau of Mines operation at Rifle, Colo. A descriptive discussion of the technology, especially retort development, an historical section, and a review of foreign activities are also included. E. B. Shultz

DENVER SHALE-OIL PLANT TO USE SWEDISH PROCESS. *Petroleum Refiner*, 35, 187-88 (1956) February; *Oil Gas J.*, 54, 43 (1956) January 23; *Chem. Eng. Progress*, 52, 52 (1956) February; *Chem. Eng.*, 63, 104 (1956) March: *Chem. Eng. News* 34, 1128 (1956) March 5.

Denver University Research Institute will develop a new Swedish (Aspeco and Co.) shale-oil process for Oil Shale Corp. by terms of a $250,000 contract. The 24-ton/day pilot unit is hoped to cut the cost of shale oil production from 16 to 13 cents/gal. The process was described by Dr. C. H. Prien of the Institute as utilizing a new method of solid-to-solid heat exchange with steel balls heated to 1000° F, moving through a revolving ball mill countercurrent to raw oil shale. The hot metal balls heat and crush the shale, and volatile matter is removed. Some condenses to a high-quality oil and some remains as a high-heating value marketable fuel gas similar to natural gas. Spent shale particles are burned to heat the steel balls. Water is needed only for the condenser, and since there is no actual combustion in the retort drum, there is no nitrogen to contaminate the fuel gas by-product. E. B. Shultz

7. ANALYTICAL METHODS AND TESTS

Combustion Method

Ingram, G. THE RAPID MICRO-COMBUSTION PROCEDURE. *Chem. and Ind.* (British), No. 5, 103-10 (1956) February 4.

Rapid and simple micro-combustion methods have been developed for determination of C, H, halogens, S, and N. In the determination of C and H, the sample is burned in an empty baffled combustion tube in a stream of oxygen. Sulfur oxides are retained by hot silver in the combustion tube; nitrogen oxides are absorbed by manganese dioxide at room temperature in an absorber connected between the water and carbon dioxide absorbers. The determination requires only about 30 min. and the apparatus is easily maintained since the absorption reagents do not require conditioning or replacement after periods of idleness. The same rapid combustion procedure is applied to determination of Cl, Br, I, S, and N using various methods for finishing. D. M. Mason

Flame Spectrometer

Vallee, B. L. and Margosches, M. INSTRUMENTATION AND PRINCIPLES OF FLAME SPECTROMETRY: MULTICHANNEL FLAME SPECTROMETER. *Anal. Chem.*, 28, 175-79 (1956) February.

An instrument for the simultaneous photoelectric determination of sodium, potassium, magnesium, calcium, and strontium, using a flame source, is described. Detection of as little as 0.002 gamma of sodium in 1 ml. of water is possible. The precision of the instrument is within 1 to 2%. R. R. Amrine

Gas Chromatography

Wiseman, W. A. APPARATUS AND TECHNIQUE: THE USE OF HELIUM AS THE MOBILE PHASE IN GAS CHROMATOGRAPHY. *Chem. and Ind.* (British) No. 7, 127-129 (1956) February 18.

Helium is compared to nitrogen with regard to retention time, sensitivity of detection of effluent substances, and cost, for the use entitled above. D. M. Mason

Gas Solubility

Bockelmann, J. B. and Hanft, C. (assigned to The F. and M. Schaefer Brewing Co.) TESTING DEVICE FOR DETERMINING VOLUME OF GAS IN LIQUID. U. S. 2,736,190 and 2,736,191 (1956) February 28.

This invention relates to a durable and portable device for determining the vapor pressure of a gas in saturated liquids and more particularly for determining the percentage of CO_2 in beer. R. F. Bukacek

Laboratory Precision

Walter, J. T. HOW RELIABLE ARE LAB ANALYSES? *Petroleum Ref.*, 35, 106-108 (1956) February.

Methods for measuring the precision of laboratory analyses and use of control charts to improve performance are discussed. D. M. Mason

Plant Wastes

Ludzack, F. J. and Whitfield, C. E. DETERMINATION OF HIGH BOILING PARAFFIN HYDROCARBONS IN POLLUTED WATER. *Anal. Chem.*, 28, 157-60 (1956) February.

Investigation of oil pollution in surface water has frequently been confused by analytical problems. The methods may have failed because of incomplete recovery of oily materials, lack of identification of the major components, or inadequate removal of interference. The proposed method includes an improved wet extraction procedure, infrared analysis for quantitative and classification purposes, and chromatographic separation to isolate mineral oils from animal or vegetable oils, soaps, and miscellaneous extractable components found in polluted water. This procedure makes it possible to determine the amount, type, and condition of oily residues in the presence of mixed components in polluted water. Authors' Abstract

Radioisotope Techniques

Johnson, A. C. ATOMIC ENERGY SERVES OIL INDUSTRY. *World Oil*, 142, 46-49 (1956) February 1.

The oil industry is today the largest user of radioisotopes. These are used in such operations as gamma ray exploration and logging, control of acidizing and fractioning jobs, determination of cut points, between different fuels for liquid fuel pipelines, in refining operations, and particularly in research. B. E. Eakin

Sulfur Method

Bethge, P. O. DETERMINATION OF SULFUR BY WET COMBUSTION WITH PERCHLORIC ACID. *Anal. Chem.*, 28, 119-22 (1956) January.

Difficulties in the determination of sulfur in wood and pulp samples by the conventional method of Grote and Krekeler have been overcome by applying a wet combustion technique, using perchloric and nitric acids. The sulfur is reduced to hydrogen sulfide, by boiling with a reduction mixture, and determined iodometrically. The method gives quantitative yields for pure organic compounds and is suitable for a great variety of samples with sulfur contents from 0.01 to 100%. Sample weights can be varied from 9 mg. to 5 grams. Author's Abstract

X-Ray Technique

Coulter, A. W., Madding, C. M., and Rosene, R. B. X-RAY ANALYSIS AS A GUIDE TO CHEMICAL CLEANING. *Combustion*, 27, 55-58 (1956) February.

Analysis of scale deposit samples should identify the compounds, as well as the elements, to allow for selecting the proper chemical solvent for its removal. A x-ray procedure, using a recording Geiger counter instrument, is described for the scale analysis. Accuracy is within 10% of the amount present and can be improved if desired. Three cases with analysis and results are cited. R. R. Amrine

Wooster, W. A. AN AUTOMATIC RECORDING MICRODENSITOMETER. *J. Sci. Instr.*, 32, 457-60 (1955) December.

A complete description of an automatic recording micro-densitometer, for x-ray use, based

of the Bobson split-beam type of instrument, using a single lamp and single photo-cell. A wedge in one beam is driven back and forth, by the output of the photocell, to balance the output of the other beam. The output of a potentiometer, connected to the wedge, is used to drive a standard pen recorder. The balance position of the wedge can be determined to 1 percent. R. R. Amrine

8. GENERAL AND PHYSICAL CHEMISTRY

CO Spectra

Eischens, R. P., Francis, S. A. and Pliskin, W. A. THE EFFECT OF SURFACE COVERAGE ON THE SPECTRA OF CHEMISORBED CO. *J. Phys. Chem.*, 60, 194-201 (1956) February.

The spectra of chemisorbed CO were studied as a function of surface coverage over silica-supported Pt, Pd and Ni in an attempt to determine the relative importance of surface heterogeneity, and interaction between adjacent molecules. Changes in the spectra of chemisorbed CO observed when the surface coverage on Pt was varied are due to interaction effects. E. Mann

Diffusion

Thomas, W. J. and Watkins, S. B. THE SEPARATION OF COMMON GASES BY THERMAL DIFFUSION. *Chem. Eng. Science*, 5, 34-49 (1956) February.

Pilot plant data are given for thermal diffusion of common gases. Effects of temperature, concentration, flow conditions and system dimensions were studied. Equations previously deduced for isotope separation are applicable for hydrogen, carbon dioxide, carbon monoxide, oxygen, nitrogen mixtures only in limited cases. E. B. Shultz

Equilibria

Buchsbaum, N. N. PLOT VAPOR-LIQUID EQUILIBRIUM DIAGRAMS FASTER. *Chem. Eng.*, 63, 168-170 (1956) February.

Here's a new whack at the old bugaboo of getting equilibrium diagrams. It is a new chart that can eliminate most of your calculations. And it easily accounts for changes in volatility. Author's Abstract

Fluid Density

Martin, A. J. (assigned to National Research Development Corp.) MEANS FOR MEASURING THE DENSITY OF A FLUID. U. S. 2,728,219 (1955) December 27.

This patent concerns a means for measuring the density of a fluid. It is essentially a flow network analogy to the Wheatstone bridge. R. F. Bukacek

Gas Theory

Canjar, L. N. THERE'S A LIMIT TO USE OF EQUATIONS OF STATE. *Petroleum Ref.*, 35, 113-16 (1956) February.

The mixture rules used extensively by engineers in predicting the P-V-T and phase behavior of hydrocarbon systems are invalid under certain conditions because of their simplicity. To propose a more correct set of mixture rules would increase the complexity of the equations to a point invalidating their usefulness for practical design engineering. This article analyzes the limitations of the existing equations of state and points out the areas where their use is invalid. B. E. Eakin

Taylor, W. J. REFINEMENT OF THE LENNARD-JONES AND DEVONSHIRE THEORY OF LIQUIDS AND DENSE GASES. *J. Chem. Physics*, 24, 454-59 (1956) February.

The Lennard-Jones and Devonshire theory of liquids represents an advance over early free-volume theories, in that each molecule is assumed to move in a potential field generated by its neighbors. This theory has been refined by the authors to account for the relative motion of neighboring particles. The present correction for correlation of neighboring molecules is applicable even for single occupancy, and is thus an addition to the communal entropy correction. This development is similar to the "cell-cluster" theory of de Boer. B. E. Eakin

Ion Exchangers

Kressman, T. R. ION-EXCHANGE MATERIALS AND THEIR APPLICATIONS IN INDUSTRY. *Chem. and Ind.* (British) No. 3, 64-69 (1956) January 21.

Use of ion-exchange materials for water purification, purification of dyes, acid and base catalysis, and desalting of brackish waters is reviewed. D. M. Mason

9. ORGANIC CHEMISTRY

Ammonia Plant

HOW SOHIO MAKES AMMONIA. *Petroleum Processing* 11, 47-50 (1956) February.

The new Sohio Chemical Ammonia plant at Lima, Ohio is expected to be in full production by the summer of 1956. Principle products are anhydrous ammonia, urea, nitric acid, nitrogen solutions and dry ice. Feed stocks are natural gas and catalytic reformer off-gas. Principle features of the plant are pressure steam reforming for synthesis gas production and the Inventa process for urea synthesis. The plant equipment is described and process flow sheets shown. J. M. Reid

Aromatic Synthesis

Seelig, H. S. and Weck, H. I. (assigned to Standard Oil Co.) CATALYTIC SYNTHESIS OF AROMATIC HYDROCARBONS FROM CO and H_2. U. S. 2,727,055 (1955) December 13.

A process is described which is similar to that of Fischer and Tropsch. However, instead of using iron catalysts which yield aliphatic and oxygenated compounds, the authors specify an alumina catalyst freed of alkali metal oxide which they claim results in high yields of aromatics. E. B. Shultz

CS_2 Manufacture

Macdougall, I. C. (assigned to Stauffer Chemical Co.) MANUFACTURE OF CARBON BISULFIDE. U. S. 2,733,984 (1956) February 7.

This invention relates to the process for producing carbon disulfide by reacting sulfur with carbonaceous materials, such as hydrocarbons, charcoal, coal, or coke. High temperature and in the case of hydrocarbon feed, high pressure are advantageous conditions for the reaction, but are difficult to attain due to the corrosivity of sulfur at high temperature. These difficulties are obviated by heating the sulfur in two stages: first in a conventional vaporizer and superheater using cheap fuel up to a temperature at which ordinary materials such as cast iron or steel are suitable, then in an electrical resistance furnace using corrosion-resistant ceramic materials of construction and relatively non-reactive materials such as graphite, electrode carbon, or carborundum as electrical conductors. D. M. Mason

Ethylene Process

ETHYLENE BY STEAM-PYROLYSIS OF PETROLEUM STOCKS. *Petroleum Processing*, 11, 87-89 (1956) February.

A process for the conversion of feed stocks ranging from refinery gas to heavy gas oil by high temperature pyrolysis in a steam atmosphere is described. The principle product is ethylene, however, salable by-products consisting of propylene, butylene and butadiene, gasoline and heavy fuel oil are also produced in significant quantities. A flow sheet for a complete plant starting with crude oil feed together with the economics for a 5000 b/d capacity are given with the process discussion. J. M. Reid

Gas Chemicals

Hester, A. S. and McDonald, J. F. NATURAL GAS HYDROCARBONS FOR PETROCHEMICALS. *Ind. Eng. Chem.*, 48, 168-77 (1956) February.

This article reviews the expansion of extraction plants from the first recovery of natural gasoline from natural gas to the present day where even ethane is being extracted for petrochemical production. Included are such topics as dehydration prior to extraction, absorption in light oils, fractionation, refrigeration and instrumentation. Flow sheets of natural gas hydrocarbons for petrochemicals at Tuscola, Ill. are presented along with many pictures of the equipment and references to 44 recent articles on petrochemical processes. B. E. Eakin

Phthalic from Xylene

Aroyan, H. J. and Wilkes, J. B. (assigned to California Res. Corp.) PROCESS OF PRODUCING PHTHALIC ACIDS. U. S. 2,734,079 (1956) February 7.

Improvements are claimed in the production of phthalic acids by oxidation of xylenes with water, ammonium sulfate and an inorganic sulfur component containing surfur at a valence below plus six. Digestion at temperatures from 450 to 630° F. at pressures up to 1600 psig prior to decolorization, to reduce losses of product, is involved. E. B. Shultz

Sulfur Chemicals

Hatch, L. F. SULFUR COMPOUNDS FROM PETROLEUM. *Petroleum Ref.*, 35, 138-42 (1956) February.

Some of the sulfur compounds occurring in

petroleum or petroleum product streams have become valuable commercial chemicals. A number of these can be separated from petroleum product streams or can be produced from petroleum-derived hydrocarbons. Synthesis and uses of such sulfur compounds as sulfur, mercaptans, sulfides, disulfides, and sulfones are described. D. M. Mason

10. CHEMICAL ENGINEERING

Bubble-Cap Trays

Bolles, W. L. OPTIMUM BUBBLE-CAP TRAY DESIGN. *Petroleum Processing*, 11, 65-80 (1956) February.

Part 1 of a series on bubble-cap tray design, this article considers tray dynamics in great detail. There are given some 66 questions and 20 figures for use in determining slot opening, liquid heights and gradients, slot seals, and vapor pressure drop and distribution.

R. F. Bukacek

CO_2 Absorption

Roper, G. H. ABSORPTION OF CARBON DIOXIDE BY CARBONATE SOLUTIONS IN A DISC COLUMN. *Chem. Eng. Science*, 4, 255-64 (1955) December.

The results from a study of various factors affecting the rate of absorption of carbon dioxide by carbonate solutions in a Stephens-Morris disc column are presented. Correlations of the data obtained and a comparison of the results with those of Comstock and Dodge involving the same absorptions in a packed column are presented. R. F. Bukacek

Data Evaluation

Winn, F. W. NOMOGRAMS: MAKE YOUR OWN. PART III. HOW TO PREPARE DIFFERENT TYPES OF NOMOGRAMS. *Petroleum Refiner*, 35, 121-26 (1956) February.

This is Part III of a four-part series on preparing nomograms for various types of equations. R. T. Ellington

Distillation

Nielsen, C. H. (Editor) DISTILLATION IN PRACTICE. New York: Reinhold Publ. Corp., (1956).

This book is a collection of papers presented at a special one-day meeting in the Spring of 1954, sponsored by the Philadelphia-Wilmington Section of the A.I.Ch.E. in collaboration with the Dept. of Chem. Engr., University of Pennsylvania. The idea was to bring a group of experienced engineers face to face with an audience of young engineers and proved to be very successful. The papers included in the 130 pages of this book are concerned with present practices in distillation. The first article is by C. Pyle of duPont on the over-all tower design from a process viewpoint. Included are discussions of materials of construction, choice of plate or packed type, determination of optimum reflux, calculating the number, kind, and spacing of plates, and many other column design factors. Graphs, pictures and drawings illustrate the article, which includes 16 selected references. The second article is by R. L. Geddes, Badger Division of Stone and Webster, on the physical design features of plate columns. Types of plates, caps, weirs, downcomers, foam and foaming problems; sieve, turbogrid and other types of trays are discussed in this well illustrated paper. C. H. Brooks of Sun Oil Co. presented the third in this series on some techniques in petroleum fractionation. Basically he utilized the principles generally covered in the text books, but applied in such unconventional manner as to be scarcely recognizable. Distillation control was discussed by W. O'Connor of the Lummus Co. and presented a review of instrumentation techniques applied to separation operations. Emphasis was placed on the fact that while instruments can guide a process, they can never replace good design in the column. Some of the practical problems of the operation of distillation equipment were presented by C. E. Strong of Hercules Powder Co. These ranged from such problems as what causes flooding and loss in tray efficiency to who left their overalls in the downcomer. This is a well written and witty article. The sixth and final paper was presented by W. A. Hall of Atlantic Refining Co. on some commercial aspects of vacuum distillation. The article describes everything from molecular stills to colums 25 feet in diameter requiring 10,000 pounds per hour of steam to run the vacuum jets alone. All articles are well written and illustrated, and the book should provide insight into the problems associated with the design and operation of distillation equipment.

B. E. Eakin

Flow Measurement

Murdock, J. W., Foltz, C. J., and Gregory, C. EFFECT OF A GLOBE VALVE IN APPROACH PIPING ON ORIFICE-METER ACCURACY. *Amer. Soc. Mech. Eng. Trans.*, 78, 369-71 (February) 1956.

This paper presents the results of a series of steam and water tests on sharp edged orifice plates preceded by a globe valve at various distances. In sum, the AGA-ASME recommended minimum lengths of straight run pipe before the orifice are shown to be adequate.

R. F. Bukacek

Fluid Flow

Coppage, J. E. and London, A. L. HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF POROUS MEDIA. *Chem. Eng. Progress*, 52, F57-63 (1956) February.

The results of a study of the heat transfer and flow friction characteristics of porous media constructed of wire screens and spheres are presented. The heat transfer and friction factor data were obtained using 6 different wire mesh sizes and 0.0818" diameter spheres for a range of Reynolds numbers from 5-1000 and are presented graphically. This data is compared with that of previous investigators.

G. G. Wilson

Galegar, W. C., Stovall, W. B. and Huntington, R. L. REPORT ON TWO-PHASE VERTICAL FLOW. *Pipe Line Ind.*, 4, 38-40, 42 (1956) February.

A report of data obtained on two phase vertical flow of the systems water-air and kerosene-air.

R. F. Bukacek

Mist Removal

Campbell, J. M. MIST EXTRACTION—AN ART, OR A SCIENCE? *Oil Gas J.*, 54 93-94 (1956) February 6.

The first of several articles on mist extraction, this one presents some general principles.

R. F. Bukacek

Plant Wastes

Institution of Gas Engineers. DISPOSAL OF GAS WORKS EFFLUENTS. International Gas Union, 6th Conference, New York (1955).

Information received from thirteen countries on the subject of the disposal of gas work effluents is summarized. S. Volchko

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Dust Removal

Jahn, R. RECENT DEVELOPMENTS IN SONIC DUST-EXTRACTION PROCESSES. *Eng. Digest* (British), 17, 21-23 (1956) January.

A summary is given of the results obtained in the sonic treatment of dust-laden gases in the audible range. Tests were carried out at gas flame rates of 106 to 176 MCF per hour at temperatures between 120° and 570° F. with dusts from ferro-silicon and carbide furnaces, from iron oxide, from cobalt oxide and from ash from steam-boiler combustion furnaces. Treatment was at frequencies between 1500 and 300 cps. Dust extraction in the audible sonic range was found to produce considerably increased flocculation and dust agglomeration. The maximum energy consumption for the sonic dust-extraction equipment was estimated at 220 W per 1000 cu. meters (35 MCF) per hour of gas treated. E. J. Pyrcioch

Stairmand, C. J. THE DESIGN AND PERFORMANCE OF MODERN GAS-CLEANING EQUIPMENT. *J. Inst. Fuel* (British), 29, 58-81 (1956) February.

A review is presented of the principal dust separating equipment for industrial use such as: cyclones, electrostatic precipitators, fibre and fabric filters. Also included are wet washers of the following types: impingement scrubbers, disintegrators, spray towers and venturi scrubbers. A short discussion of the mechanism of operation of each is given along with grade-efficiency curves based on plant test data. A correlation is developed relating cost and dust removal efficiency. Procedures are summarized for determining the efficiency of industrial dust separating equipment. E. J. Pyricoch

Gas Handling Safety

Crowe, J. J. SAFETY AND COMPRESSED GASES. *Ind. Eng. Chem.*, 48, 230-32 (1956) February.

Safety in the transportation and handling of compressed gases starts with the manufacture of the container. Containers complying with the requirements of the Interstate Commerce

Commission specifications are safe only if periodically retested as provided by the ICC regulations, and are properly handled between times. By using safe containers, a good classification of the gases, and local ordinances and national codes governing the storage of compresed gases, many serious accidents can be avoided.

Author's Abstract

Gas Reactor

Odell, W. W. PROCESS OF TREATING GASIFORM FLUIDS AT ELEVATED TEMPERATURES. U. S. 2,731,335 (1956) January 17.

This invention concerns process for treating gases or gasified liquids wherein; a reaction temperature in the range 400 to 1600° F. is required; the reactants are first preheated in an inlet zone, then are reacted in an intermediate hot zone, and the products are immediately thereafter rapidly cooled in an outlet zone; flow through the reactor is periodically reversed to effect heat recovering, the high temperature in the reaction zone is maintained by the heat of reaction of the flowing stream. Reactions which may be promoted include oxidation of CS_2 of HCN from ammonia, cracking of hydrocarbons, hydrogenation of nitric oxide, and oxidation of H_2S with oxygen. Examples of such treating processes include the conversion of CS_2 in oil gas to H_2S by passage through a hot zone maintained at 1300 to 1600° F. in the presence of steam and a small amount of oxygen whose reaction furnishes the heat required to make up heat losses; a modification of the above process wherein H_2S in natural gas is converted to elemental sulfur; production of aromatics and butadiene by cracking naphtha; removal of NO from gas containing H2.

D. M. Mason

Spray Scrubber

Van Ackeren, J. (assigned to Koppers Company, Inc.) SPRAY TYPE GAS AND LIQUID SCRUBBER. U. S. 2,733,054 (1956) January 31.

This invention relates in general to apparatus for intimate contact of gas with the liquid in the form of a spray, to remove constituents of the gas by the liquid or to remove constituents of the liquid by means of the gas.

R. F. Bukacek

12. MATERIALS OF CONSTRUCTION

Cathodic Protection

Sudrabin, L. P. A STUDY OF PROTECTIVE CRITERIA ON A PIPE SECTION IN A UNIFORM ENVIRONMENT. *Corrosion*, 12, 60t-66 (1956) February.

The use of a model pipe section to study the effect of the reference electrode location on the meaning of the pipe to reference electrode potential is described. Test results obtained by use of this model and the practical significance are discussed. G. G. Wilson

Coatings

Brand, B. G., Fink, F. W., Hudson, G. A., and Mueller, E. R. AN EVALUATION OF ORGANIC COATINGS FOR USE IN CATHODICALLY PROTECTED DOMESTIC HOT-WATER TANKS. *Paint and Varnish*, 46, 25-32 (1956) January.

The results of a laboratory study of light organic coatings for use in hot water tanks is presented. The tests run included a thermal shock test, an alkali resistance test, and tests of the effect of cathodic protection current on the coating materials. Best performance was obtained with a coating based on an epoxy-phenolic resin. G. G. Wilson

Nicholson, D. H. ANTI-CORROSIVE APPLICATIONS OF 'EPIKOTE' RESINS. *Corrosion Techn.* (British), 3, 4-7, 18 (1956) January.

The chemical and physical properties of coatings based on epoxy resins are briefly discussed and several examples of typical applications of epoxy resin based coatings are presented.

G. G. Wilson

Reilly, C. B. and Orchin, M. PRODUCT AND PROCESS DEVELOPMENT: PREPARATION AND PROPERTIES OF POLYURETHANE COATINGS. *Ind. Eng. Chem.*, 48, 59-67 (1956) January.

The development and properties of a polyurethane coating to resist rain erosion of the leading edges of high speed aircraft are described. This coating was prepared from 2,4-tolylene-diisocyanate and polyethylene adipate cross-linked with ethanolamine. Its performance in mock-up tests was excellent. G. G. Wilson

Corrosion

Allen, C. H. and Tauschek, M. J. CORROSION OF GASOLINE ENGINE EXHAUST VALVE STEELS. *Corrosion*, 12, 39-47 (1956) January.
The corrosive environment surrounding the exhaust valves in gasoline engines is considered in connection with the types of corrosion that can occur there. Included in the discussion are valve face, valve head, valve steam and weld junction corrosion. A method of evaluating the corrosion resistance of exhaust valve steels is given. The effect of analysis variation in the chromium-nickel, chromium-nickel-manganese and chromium-nickel-cobalt steels as it influences corrosion is presented. Other matters discussed include the influence of silicon on the corrosion of valve steels, the effect of a variation in nickel-iron content on aircraft valves, and the use of valve rotators in reducing exhaust valve corrosion. Authors' Abstract

Hair, W. J. CORROSION WORK BY BRITISH RAILWAYS RESEARCH DEPARTMENT. *Corrosion Tech.* (British), 3, 8-11 (1956) January.
The organization and function of the British railways research department is outlined and the types of corrosion problems that this department has worked on are briefly surveyed. G. G. Wilson

Kear, R. W. LOW-TEMPERATURE CORROSION BY FLUE-GAS CONDENSATES. PART I. *Corrosion Techn.*, (British), 3, 59-64 (1956) February.
A review of the corrosion problems produced by flue gas condensates. The mechanism of this type of corrosion is briefly considered, physical and chemical methods of assessing this corrosion damage are outlined, and the role of sulfur oxides in flue gas corrosion problems is discussed. The results of previous laboratory studies of flue gas corrosion problems are summarized. G. G. Wilson

Spalding, J. C., Jr. HOW TO SELL CORROSION CONTROL TO MANAGEMENT. *World Oil*, 142, 170-72, 175-76 (1956) January.
The manner in which Sun Oil Company's corrosion engineers sold management on their corrosion control program is described and key factors were sound economics, accurate records and a good presentation. G. G. Wilson

Plastics

Sharp, W. H. and Weber, M. K. EFFECT OF WATER ON STRENGTH OF STRUCTURAL PLASTICS. *Corrosion*, 12, t71-78 (1956) February.
Evidence is presented to show that glass reinforced plastics undergo substantial reductions in strength when exposed to water. Emphasis is placed on the importance of determining the total loss of strength by creep measurements in the environment and at the temperature of interest. Results from such measurements are much more revealing than the commonly used method of short term immersion followed by rapid ultimate strength measurements in air. Convenient methods are described for obtaining comparative creep strength data for resins, for flat laminates and pipe sections. Results obtained from these methods are used to indicate the most important factors which determine the wet strength of resin and of glass reinforced resin. Authors' Abstract

Refractories

Majumder, B. L. ZIRCON AS A REFRACTORY MATERIAL—PART II. *Ceramics* (British) 7, 497-99 (1956) February.
Zircon bricks have shown good resistance to coal ash slags according to tests in coal and coke fired furnaces. However, under reducing conditions at high temperature, the performance of the zircon bricks was not satisfactory and there was some reaction with basic iron slags. Due to their low coefficient of thermal expansion, zircon bricks are very resistant to thermal shock showing no failure in 30 cycles of testing and cooling. Zircon refractories are reported to be used for burning chambers for hydrocarbon gases used in catalytic processes and for burning chambers in units manufacturing synthetic gasoline. E. J. Pyrcioch

Vogrin, C. M. and Heep, H. NEW TESTS ON CASTABLES. *Petroleum Refiner*, 35, 158-62 (1956) February.
The application of insulating and refractory castables in petroleum industry plants continues to increase. You will need to know just how these materials can be expected to perform and what certain service conditions can do. Here is up to the minute test data that answers many questions about castables that you have possibly asked. Authors' Abstract

Tank Losses

Hoffman, E. L. THE EFFECT OF PAINT COLORS IN REDUCING STORAGE-TANK LOSSES. *Pipe Line News*, 28, 44-47 (1956) February.

The frequency of repainting required for storage tanks and the costs of labor and materials required to accomplish repainting are briefly considered and the conclusions drawn from this study of the effect of colors on storage tank losses are summarized. Twelve short tables of data are included. G. G. Wilson

Welding

Reed, P. WHAT'S AHEAD IN NONMANUAL WELDING? *Oil Gas J.*, 54, 80-84 (1956) February 6.

The results of an investigation of the applicability non-manual welding processes for pipeline work conducted by the Esso Research and Engineering Co. are presented. The most promising process is reported to be a process utilizing a carbon dioxide shielded arc. G. G. Wilson

13. NEW BOOKS

(C. A. Simms, Librarian)

Refrigeration

Althouse, A. D. and Turnquist, C. H. MODERN REFRIGERATION AND AIR CONDITIONING. New Ed. Chicago: The Goodheart-Willcox Co., 1956.

The text has been completely rewritten with much new material added. It covers the practical applications of refrigeration in all of its branches. It teaches refrigeration and air conditioning principles.

Instruments

Holzbock, W. G. INSTRUMENTS FOR MEASUREMENT AND CONTROL. New York: Reinhold Publishing Corp., 1955.

Written in non-mathematical language, this is one of the first books to describe and illustrate all the most recent devices for measuring and controlling temperature, moisture, pressure, flow, and uniformity. It discusses the design, construction and operation of instruments, shows how various instruments compare with each other, and points out the factors to consider in choosing the proper instrument for a particular job.

Chemical Bond Theory

Ketelaar, J. A. A. CHEMICAL CONSTITUTION. Amsterdam: Elsevier Publishing Co., 1953.

"An introduction to the theory of the chemical bond."

Applied Mathematics

Margenau, H. and Murphy, G. M. THE MATHEMATICS OF PHYSICS AND CHEMISTRY. 2nd ed. Princeton, N. J.: D. Van Nostrand Co., 1956.

This book is ideal for general use in applied mathematics as well as for thermodynamics, statistical mechanics and quantum mechanics. It provides the essential tools for solving the mathematical problems met in physics and chemistry.

Thermo-chemistry

Rossini, F. D., Editor. EXPERIMENTAL THERMOCHEMISTRY: MEASUREMENT OF HEATS OF REACTION. New York: Interscience Publishers, Inc., 1956.

This book was prepared under the International Union of Pure and Applied Chemistry by the Subcommission of experimental thermochemistry. Its object is to "place before the scientific and technical world, the best knowledge of the members and advisors of the Commission relative to the experimental thermochemistry and the measurement of heats of chemical reactions."

Hydrogen Peroxide

Schumb, W. C., Satterfield, C. N. and Wentworth, R. L. HYDROGEN PEROXIDE. ACS Monograph Series No. 128. New York: Reinhold Publishing Corp., 1955.

This is a comprehensive treatment of the manufacture, properties, technology and uses of hydrogen peroxide. It contains information on experimental techniques never before published. There are more than 2,500 literature references.

Minerals Yearbook 1953

U. S. Bureau of Mines. MINERALS YEARBOOK, Vol. II, FUELS. 1953. Washington, D. C.; Govt. Print. Office, 1956.

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American Chemical Society. Journal
American Gas Association Monthly
American Gas Journal
American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
American Society of Mechanical Engineers. Transactions
Analytical Chemistry
Appliance Manufacturer
Applied Spectroscopy
Association for Computing Machinery, Journal
Australian Journal of Applied Science
Australian Journal of Chemistry

Bituminous Coal Research Reports
Brennstoff-Chemie
British Coal Utilization Research Association Monthly Bulletin and Quarterly Gazette
Butane-Propane News

California Oil World
Canadian Chemical Processing
Canadian Gas Journal
Canadian Journal of Chemistry
Canadian Journal of Physics
Canadian Journal of Technology
Chemical and Engineering News
Chemical and Process Engineering
Chemical Engineering
Chemical Engineering Costs Quarterly
Chemical Engineering Progress
Chemical Engineering Science
Chemical Processing
Chemical Reviews
Chemical Society (London) Journal
Chemical Week
Chemistry and Industry
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Drilling

Engineers' Digest
Erdöl und Kohle

Faraday Society. Transactions
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Fuel Efficiency
Fueloil and Oil Heat

Gas
Gas Age
Gas and Oil Power
Gas Council (British) Publications
Gas Heat
Gas Journal
Gas Times
Gas und Wasserfach
Gas World

Heating, Piping and Air Conditioning

Independent Petroleum Association of America Monthly
Industrial and Engineering Chemistry
Industrial Finishing
Industrial Gas (American)
Industrial Gas (British)
Industrial Heating
Institute of Fuel (British). Journal
Institute of Gas Technology Publications
Institute of Petroleum (British). Journal
Institution of Gas Engineers. Bulletins, Communications and Transactions
Instruments

Jet Propulsion
Journal des Usines a Gaz
Journal of Applied Chemistry
Journal of Applied Mechanics
Journal of Applied Physics
Journal of Chemical Physics
Journal of Metals
Journal of Organic Chemistry
Journal of Petroleum Technology
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Journal of Research (National Bureau of Standards)
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Mathematical Aids
Mechanical Engineering
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National Advisory Committee for Aeronautics, Reports
National Fire Protection Association Quarterly
National Gas Bulletin of Australia
National Petroleum News

Official Gazette of the U.S. Patent Office
Oil and Gas Journal

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Petroleum Engineer
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Petroleum Refiner
Physics Today
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